

ON SOME GENERA OF THE PIMPLINE
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INTRODUCTION

This paper is the result of three years' work done at the Massachusetts Agricultural College as a partial requirement for the degree of Doctor of Philosophy.

I wish to acknowledge my obligations to Dr. H. T. Fernald, under whose direction this work was carried on, to C. H. Fernald for his kindly suggestions, to Dr. G. C. Crampton for valuable advice and criticism, to W. S. Regan for the valuable assistance rendered me by securing specimens for study from the museums at Philadelphia, Washington, and New York, and making notes on the comparisons of these insects with their types, and to Dr. C. Gordon Hewitt for the loan of a large number of specimens.

Mr. F. A. Johnston began work on this group and had brought together copies of the descriptions of nearly all the insects treated here, when he accepted a position with the Bureau of Entomology, and the subject was given to me to continue.

Fourteen species and four genera are treated here. Of these, one genus and one species are described for the first time. Most of the other North American species are redescribed, wherever it was possible to obtain specimens from which to make the descriptions. The genus *Epirhyssa* has been abandoned, as it did not seem to have enough distinctive generic characteristics to separate it from *Rhyssa*. A new genus *Pseudorhyssa* has been established. Its transversely wrinkled mesonotum places it within the scope of the genera treated here; the entire sternal plates of its abdomen, however, separate it from the other genera. The type of this genus, *Pseudorhyssa sternata* is here described. The description of *Thalessa histrio*, an unlocated species, is also included.

Probably the largest and most valuable collection in this country of the insects treated here is at the Academy of Natural

¹ Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.

Sciences in Philadelphia. Other collections from which material used in the preparation of this paper was borrowed, were those at the National Museum in Washington, the American Museum in New York, the Museum of the Boston Society of Natural History in Boston, the Children's Museum in Brooklyn and the collection of the Dominion Entomologist of Canada. The collections at the Museum of the Academy of Natural Sciences of Philadelphia and the National Museum in Washington are especially valuable, in that a number of type specimens are located there.

HISTORICAL

Linnaeus was the first to describe insects in this group. From his time down to the present, there have been numerous workers, but beyond synoptic tables to the genera, they have done nothing except to describe some of the species.

Holmgren² called the genus *Megarhyssa*, *Thalessa*, in 1859, but Adams had used this name in 1858 for a genus of mollusks. Ashmead³ proposed the name *Megarhyssa* on account of the name *Thalessa* being preoccupied in another branch of zoölogy. Dalla Torre⁴ places "non Adams 1858" after the reference to Ashmead; this should have been placed after the reference to Holmgren.

The chief workers in this group have been Linnaeus, Fabricius, Kriechbaumer, Cameron, Cresson and Viereck. Both Cresson and Kriechbaumer not only described and named several new species but each established a new genus.

In the Proceedings of the United States National Museum for 1901, vol. xxiii, Ashmead divides the sub-family *Pimplinae* into tribes and establishes among others the tribe *Pimplini*. Up to this point his synoptic tables may be made use of, but when it is desired to determine the genera treated here it will be necessary to use a new key, because other generic values have been given to some characters, while the value of others has been lessened. The 62nd fascicle of the Genera Insectorum uses a key similar to the one used by Ashmead and the same criticism applies to it. In Cresson's Synopsis of the Hymen-

² Öfvers. Svensk. Vet.-Akad. Forh., xvi, 1859, p. 122.

³ Canadian Entomologist, xxxii, 1900, p. 368.

⁴ Catalogus Hymenopterorum, viii, p. 479.

optera, no division of the sub-family is attempted but the key is similar to the two preceding ones in the generic characters used.

The genus *Megarhyssa* is fairly constant in both color and structural characteristics, while the genus *Rhyssa* exhibits considerable variation in both. For that reason it would seem unsafe to describe a new species from a single specimen in *Rhyssa*.

EXTERNAL ANATOMY

The following description is taken mainly from *Megarhyssa lunator*. Certain modifications have been made to describe such differences as may occur in different species of the group treated here.

Head

The head is hypognathous, broader than long. Its general shape when viewed from in front is rounded-triangular. The compound eyes are large, extending from the top of the head to the clypeus. They are broad, together constituting one-half the width of the head when viewed from in front and when viewed from the side, at their widest part, forming a little more than half the width of the head. The inner margins of the compound eyes are slightly emarginated on its upper third, but nearly form two parallel lines with each other. The posterior margins are entire. The eyes are naked.

The clypeus occupies the lower portion of the front of the head and extends up to the lower borders of the compound eyes. The clypeus is narrow and elongated transversely. Laterally below the eyes it has fused with the cheeks. There is an impression reaching from the eyes to about the middle of the mandibles which suggests that it was a suture marking the division between the clypeus and the cheeks. If this is true, then the clypeus and cheeks together form the basal support of the mandibles. The lower border of the clypeus between the mandibles varies in outline, in different genera, from concave to convex. This fact is made use of in the determination of genera.

The frons, vertex, occiput and upper ends of the genae are fused, but the occiput and genae are fused dorsally, while laterally they are separated by a suture, and ventrally by a ridge. The occiput may be considered as that portion of the back of the head which is nearly vertical. It is concave from side to side, and the prothorax attaches at about its center.

The lack of definite sutures separating the plates of the head, necessitates the establishment of artificial boundaries. The vertex will be considered as extending from a line drawn through the posterior ocelli, back to a line from the ends of the sutures separating the genae from the occiput. The lateral limits of the vertex can be definitely fixed, but will be considered as extending to the compound eyes.

The portion of the head behind the compound eyes, extending from the vertex to the clypeus and back to the occiput, will be considered as the genae. The greatest width of the genae is at the lower border of the compound eyes. They gradually become narrower towards the top of the head.

The labrum is attached to the clypeus between the front borders of the mandibles. Being attached to the lower and inner side of the clypeus, it leaves the anterior borders of the latter clearly defined. The labrum bears a thick row of long spines on its outer edge.

The mandibles are situated on either side of the labrum. They are broad at the base, taper gradually toward the apex and the tip is slightly incurved. They have two teeth, the anterior one being blunt, while the posterior one is produced to a point. The maxillae lie behind the mandibles and each has a five-segmented palpus. The labium is so well concealed by the maxillae that it was impossible to separate it for careful study in the time at my disposal.

The antennae are filiform, long, slender and composed of about forty segments. They are covered by a large number of minute spines. The main portion of the scape is bluntly spindle-shaped when viewed from the mid line of the body, or from somewhat below the point of attachment. From this angle, the fact that the upper, outer side of this spindle has quite a deep, oval excavation from which the pedicel arises, is not perceptible. At its widest part, the scape is about twice as wide as the other segments. The bulb below the constriction enlarges so that its outline is triangular. The first segment of the antenna is globular and very much differentiated from the others. It is broader than long and about one-fifth the length of the second segment. The remaining segments are cylindrical and a gradual decrease in size appears on the outer half of the antenna. The

last segment is nearly twice as long as the preceding segment and narrows rather suddenly towards the tip.

Thorax

The prothorax consists of four visible plates; the notum, two episterna, and a sternum. Each episternum (Eps.₁) at its anterior end, articulates with the head by a hooked process which is the remains of the cervical sclerite. The episterna are separated ventrally by a median longitudinal suture. At the point of articulation with the head, each is quite slender, but posteriorly it enlarges and flattens out into a lobe which passes downward and backward below the pronotum and articulates at its posterior end with the procoxa (Cx.₁) of an anterior leg. As in most Hymenoptera, the episternum constitutes the greater part of the pleural portion of the prothorax, the epimeron being reduced to a strip so narrow that it is almost negligible, on the posterior border of the episternum and is hidden under the pronotum.

The pronotum (N.₁) is very broad laterally, its anterior face, being narrowed, forms a connection between the lateral plates. The sides are highly polished. The pronotum reaches the base of the tegulae (Tg.) and is produced downward to the episternum, coxae and sternum ventrally. The pronotal lobe (Pnl.) is distinct, though small, forming a peritremal sclerite overlapping the first thoracic spiracle (Tsp.). The sternum is overlapped and largely concealed by the approximated lobes of the episterna.

In the mesonotum, the prescutum, scutum and scutellum are plainly distinguishable. The postscutellum is small and for the most part is a phragma or internal process.

Near the upper, posterior corner of the pronotum, on each side and just below the anterior end of the attachment of the fore wing to the body is the first thoracic spiracle (Tsp.).

The prescutum (Psc.₂) is a triangular shaped plate, above the pronotum and separated from the scutum by two sutures which posteriorly converge and become transformed into flattened grooves. The front portion of the prescutum is nearly vertical and forms almost a right angle with its hinder portion, when viewed from the side.

Medially, the scutum (Sct.₂) extends to the raised median portion of the scutellum. Posteriorly the scutum is sunken

between the lateral plates of the scutellum (Scl.₂), so that its lateral margins are concealed. Both the prescutum and scutum are transversely rugose. The lateral margin of the prescutum is deflexed. The anterior portion of this deflexed margin is overlapped by the dorsal border of the pronotum. From the top of the pronotal lobe, just above the first thoracic spiracle, is a ridge extending to the anterior corner of the lateral lobe of the scutellum, behind which point, the margin of the scutum is concealed by this lobe, as already stated. Below and behind this ridge, the scutum bends abruptly and is somewhat hollowed, the lower margin of this portion of the plate extending backward until opposite the front end of the lateral lobe of the scutellum. The margin now turns upward and forms a suture with the front margin of the lateral lobe of the scutellum.

The scutellum (Scl.₂) consists of a median raised portion and two deflexed regions. From the front of the median portion of the scutellum a ridge runs downward on the side of the body toward the lower, hinder angle of the plate, and may be considered as marking the line between the median portion and the lateral lobe. The lateral lobe, as thus indicated, is approximately rectangular, its lower, hinder angle being somewhat drawn out and its lower border somewhat emarginated. The hinder margin of the median portion of the scutellum is practically a straight line, running obliquely backward on either side.

The fore wing has a much elongated attachment to the body, its humeral angle appearing just behind the pronotal lobe, and its internal margin near the lower, posterior corner of the lateral lobe of the scutellum. Beneath this wing attachment lies the upper margin of the mesoepisternum (Eps.₂).

The tegula (Tg.) which lies over the anterior portion of the base of the wing is a small chitinous plate, which appears to be attached medially to the front end of the hollowed portion of the scutum, just below the front edge of the ridge already described. Its real attachment and relation to the wing are considered under a separate heading elsewhere in this paper. Two tiny basal wing sclerites lie beneath the costal and anal regions of the wing.

As in the prothorax, the episternum (Eps.₂) constitutes the greater part of the pleural region. It is fused with the sternum (S.) which has a narrow, deep, mid-ventral groove extending

longitudinally throughout its whole length. On the episternum, a short distance behind its front margin, is a nearly vertical suture extending about half way up to the dorsal margin of the plate, crossing it beneath and continuous with the corresponding suture of the other side, separating the lower, anterior portion of each episternum from the remainder. This portion is called the prepectus (Ppet.₂). The epimeron (Epm.₂) is a narrow band separated from the episternum by a suture extending in a straight line from the hinder base of the fore wing downward and backward to the mesocoxa (Cx.₂). The sternal area is flat beneath, punctured and sometimes striated.

The distinguishable plates of the metanotum are the scutum, scutellum and postscutellum. The region here called metanotum is the one which has been usually termed the postscutellum of the mesothorax by the systematists. The metascutum (Set.₂) lies immediately behind the scutellum of the mesothorax. Its narrow dorsal surface is sunken below the surfaces of both the mesoscutellum and the metascutellum. Laterally it consists of two deflexed regions. The hind wings are dorsally attached by a membrane, to the scutum, and behind and below are similarly attached by a forward projecting process of the metapleuron. In the anal and humeral angles are borne the small, sub-alar basal wing sclerites. The scutellum (Sel.₃) consists of a raised median portion. Immediately posterior to the scutellum lies the postscutellum (Psel.₃) which is a sunken, narrow, transverse bank-like region fusing laterally with the metaepimeron.

The pleurum consists of an episternal and epimeral region, of which the former is much the larger. That portion of the pleurum which is fused with the metapostscutellum is epimeral (Epm.₃). The suture which separates the epimeron from the first abdominal segment becomes lost for most of the distance along the ventral margin of the latter segment, reappearing again for a short distance at its hinder, ventral portion. The main part of the episternum (Eps.₃) lies beneath the metaepimeron and its hinder margin articulates with the metacoxa (Cx.₃). The upper, anterior corner is prolonged into a narrow bank-like region lying between the mesoepimeron and the fused metapostscutellum, and metaepimeron. It is separated from each by sutures. The pleura are fused with the sternum which

is marked by a longitudinal mid-ventral groove, as in the mesothorax, and is continuous with it.

Wings

The wings are long and narrow, quite large, usually hyaline, marked more or less with dark spots. In some species the wings are entirely cloudy. The fore and hind wings are connected when in flight, by a row of frenal hooks on the hind wing hooking into the frenal fold of the front wing.

In describing the veins and cells, the terminology used by Cresson in his "Synopsis of the Hymenoptera of North America," will be followed here.

In the fore wing, the costal and subcostal veins are blended, therefore the costal cell is absent. They extend to a point a little beyond the middle of the wing, where there is a slight notch in the costa. From this notch, to a point about half way from it to the apex, is a thickened, darker strip which may be regarded as the stigma. Behind the blended costa and subcosta, lie the externo-medial and anal nervures. The externo-medial nervure at its outer end, meets the basal nerve obliquely; this basal nerve joins the subcosta at a point a little before the stigma. The cell outlined by these nervures is called the submedian or interno-medial cell. The anal nervure lies behind the externo-medial nervure and extends outward until it joins the anal margin at a point nearly two-thirds the length of the wing from the base. At the junction of the basal nerve with the externo-medial nervure, the transverse-medial nervure extends at nearly a right angle with the latter, to the anal nervure; thus outlining the submedian or interno-medial cell. Behind the anal vein and in front of the anal margin lies the long, narrow, anal cell. The marginal or radial nervure apparently arises from the hinder edge of the stigma and extends toward the apex, but before reaching it, turns forward to the front margin, thus enclosing the marginal or radial cell. The discoidal nervure extends from the junction of the externo-medial, basal, and transverse-medial nervures, outward until it joins the cubital nervure, where it bends abruptly backward and joins the anal nervure just before the latter reaches the anal margin. The cell outlined by the transverse-medial nervure

on its inner margin, the discoidal nervure on its front and outer margins, and the anal nervure on its hinder margin, is the second discoidal cell. The cubital nervure extends outward from the point where the discoidal nervure bends abruptly backward, and becomes lost a short distance before the outer margin. About the middle of the marginal nervure arises a cross nervure which passes backward and joins the cubital at about its middle. This nervure has been termed the first transverse cubital, and forms the outer margin of the very large, somewhat triangular cell lying behind the base of the stigma, called the cubito-discoidal cell. A short stump of a nervure projecting from the cubital into the cubito-discoidal cell is called by Cresson an "abbreviated cubital nervure." The real significance of this nervure will be discussed later. A short distance external to the first transverse cubital is another cross nervure, the second transverse cubital. The relation of these two nervures differs greatly, their anterior ends may be close together on the marginal nervure, while their posterior ends are some distance apart. These nervures enclose the areolet or second submarginal cell. In some cases, the anterior ends of the two transverse-cubital nervures are united for about half their length. In this case, the areolet is said to be petiolated. Occasionally, the second transverse cubital is lost or reduced to an abbreviated stub, in which case, the areolet is absent. The presence or absence of an areolet which has heretofore been used as a generic character, is not even a specific one, as both conditions have been found to occur in the same species.

The second transverse cubital nervure forms the inner margin of the third submarginal cell which extends outward to the outer margin of the wing. Its front border is formed by the outer half of the marginal or radial nervure, and its hinder border by the outer portion of the cubital nervures. Between the cubital nervure and the internal margin of the wing, extending nearly to the outer margin from about the middle of the backwardly turned portion of the discoidal nervure, is the subdiscoidal nervure. That portion of the discoidal nervure between the cubital and subdiscoidal nervures is the first recurrent nervure, according to Cresson, though here described as part of the discoidal. The second recurrent is a somewhat curved nervure

extending backward from the middle of the arcolet to near the outer end of the subdiscoidal. The recurrent nervures form the inner and outer margin of the third discoidal cell, with the cubital forming its front and the subdiscoidal joining its hinder borders. The subdiscoidal nervure forms the front margin of the first apical cell, while its inner margin is formed by the outer part of the discoidal nervure and behind it is bounded by a small portion of the anal nervure, the outer part of the internal margin, the anal angle and the hinder portion of the outer margin of the wing. Between the cubital and subdiscoidal nervures and extending from the second recurrent nervure to the outer margin, lies the second apical cell. The frenal fold is near the outer end of the anal cell.

The writer is inclined to agree with Snodgrass⁵ in his interpretation of the venation of an Ichneumonid wing, as indicated by his Figure 76, rather than with that used by Cresson.⁶

The two systems agree in the main, the points of disagreement being the discoidal and first recurrent nervures. According to the system used by Cresson, the first recurrent nervure (l.) separates the two parts of the discoidal nervure (j.).

In the fore wing of *Mellinus* which Cresson⁷ uses as a typical Hymenopteron wing, the two recurrent nervures are very distinct and there can be no question raised as to their identity. Here, the first recurrent nervure extends from the discoidal nervure (j.) to the cubital nervure (k.). In the fore wing of *Megarhyssa lunator*, the cubital nervure at its anterior end is but an abbreviated stump. According to Snodgrass, the vein from (j.) to (k.) forms the first recurrent nervure (No. 16, fig. 76). This agrees with the condition found in *Mellinus* and seems to be a more plausible explanation than calling it part of the discoidal nervure (l.) with parts of the latter on either side of it (j.). If Snodgrass's interpretation is accepted, then the discoidal nervure remains as such from beginning to end.

In *Mellinus* the first transverse cubital nervure extends forward from the point where the first recurrent nervure joins the cubital, to the marginal or radial nervure, but in the fore wing

⁵ 'Thorax of Hymenoptera,' 1910, pl. 6, fig. 76.

⁶ Synopsis of the Hymenoptera of North America, p. 38, fig. 9.

⁷ Synopsis of the Hymenoptera of North America, p. 5, fig. 4.

of *Megarhyssa lunator*, the transverse cubital nervure is lost. As a result of this, the so-called cubito-discoidal cell includes not only the first, but the second cubital cell, and the cells spoken of by Cresson as the second and third cubital cells are in reality the third and fourth cubital cells. The nervures (f.) and (g.) though called the first and second transverse cubitals are actually the second and third.

In the hind wing the nervures and cells are fewer in number than in the fore wing. The subcostal nervure runs outward from the base of the wing for nearly two-thirds the length of the latter, joining the costa at a small notch in the costal margin. From this point the radial or marginal nervure passes obliquely outward and backward to the outer margin some little distance behind the apex. Behind the subcostal lies the externo-medial nervure, which passes outward, gradually diverging from the former till intersected by two cross nervures. Beyond the intersection it continues to the hinder margin, this portion being termed the discoidal nervure. Behind the externo-medial nervure is a third longitudinal nervure which extends from the base of the wing to its hinder margin, which it reaches a short distance before the middle of the margin. The externo-medial nervure is intersected in front by the cubital nervure, the two uniting at nearly right angles. The latter abruptly turns outward, however, and gradually backward and reaches the hinder margin of the wing about half way between the ends of the discoidal and marginal nervures. At about its middle, it is joined by the hinder end of the transverse cubital nervure which passes forward, then outward, then forward and unites with the marginal nervure near its middle. From the point of intersection of the externo-medial and cubital nervures the transverse medial originates, extending backward and inward and joins the anal nervure a short distance before the latter reaches the wing margin.

The cell lying between the costa and the subcostal nervure is known as the costal cell: that in front of the marginal or radial nervure, as the marginal or radial cell: that bounded in front by the costal and part of the radial nervures, behind by the externo-medial and the inner part of the cubital nervures, and externally by the transverse cubital nervure—the largest cell of the wing—

is the median cell. Between the outer parts of the marginal and cubital nervures, external to the transverse cubital nervure is the submarginal or cubital cell. Behind this, between the cubital and discoidal nervures lies the first discoidal cell. Between the externo-medial and anal nervures and extending from the base of the wing to the transverse medial nervure, lies the submedian cell, external to which and separated from it by the transverse medial nervure lies the second discoidal cell. The area behind the anal nervure is known as the anal cell.

Legs

The legs are long and slender, the coxa being the stoutest part of each leg. The coxae, trochanters, femora and tibiae, which are clothed with minute hairs or spines, are sometimes almost pubescent. At the outer end of each tibia are two long spines of unequal length, on the sides towards the body. The tarsi are covered with short spines becoming longer at the end of each segment.

On the fore legs, the coxae are large, but are the shortest ones of the three sets. Each is sub-conical in form, with the trochanter articulating at its apex. The trochanter is well developed and composed of two segments, the first being the larger. Its base is cylindrical, but at the tip of the second section where it articulates with the femur it is flattened.

The fore femur is the shortest of any. At its articulation with the trochanter, it is flattened and for a short distance it decreases in width. It then begins to widen and thicken, becoming sub-cylindrical just before articulating with the tibia.

The fore tibia is the only one which is shorter than its femur. It is narrow and cylindrical at its base of articulation, but gradually increases in size to its outer end. Its outer side is clothed with short spines.

The tarsus is composed of five segments, all of which are cylindrical and slightly enlarged at their outer ends. They decrease in length from the tibia outward to the fifth segment which is slightly longer than the fourth. On that portion of the tarsus overlapped by the tibial spurs is a raised area, which together with the latter, forms a cleaning apparatus. The longest spines of the tarsus are found at the tip of the fourth

segment. At the tip of the fifth is a pair of strong, well-developed, incurved claws, between which is a large pulvillus.

The middle coxa is larger than the fore coxa and is more cylindrical than conical. The middle femur is straighter and longer than the fore femur. At its base it is narrow, but soon broadens out and remains the same width for the rest of its length. The middle tibia is longer than the fore tibia and also longer than the middle femur. In all other respects the middle leg is like the fore leg.

The hind legs are the longest and in all respects they resemble the middle legs rather than the fore legs.

Abdomen

The abdomen consists of nine visible segments. It is depressed behind the propodeum but towards the end is mostly compressed. It has lateral impressed lines on segments three to six, which converge toward the middle of the base. The abdomen is sometimes finely, transversely aciculated. The dorsal portion is coriaceous.

The first segment of the abdomen is the median segment or propodeum, and has often been considered to be part of the metathorax. Anteriorly it articulates with the metapostscutellum and the metaepimeron. The latter extends along its lower border. The sternum of this segment is either lost or has fused with the metasternum. The pleural elements have fused with the notum forming a single continuous plate. It is usually smooth, but in some cases has a channeled groove along its mid-dorsal line and may even be areolated. The presence or absence of these areolations is used for generic distinction. On either side it bears a large spiracle, these forming the largest spiracles found in the abdomen.

The actual second segment, usually rated as the first by systematists, is constricted at its base, joining the true first segment or propodeum as by a stem. Its attachment is such that it is enabled to articulate freely. Here as in all the rest of the segments, the pleura are fused with the notum. It is straight, with its spiracles placed before the middle and closer to each other than to the apical margin. These facts are made use of in classifying to the tribe. At the base of this segment, the fused

notum and pleura become fused with the sternum for a greater or lesser distance. The amount of this fusion is used in classification to species, and the presence or absence of it is made use of for generic distinction. The sternum is divided into an anterior and a posterior portion by a transverse groove. The latter portion is again divided into two parts by a longitudinal mid-ventral groove.

Considerable variation from the typical form in regard to the construction of the sternal plate has been found. A large part, often as much as half of the posterior portions of this plate may be membranous in place of being mainly composed of chitin, as is the case in some species. It is impossible to determine whether this characteristic is the primitive condition or is a degeneration, though the weight of evidence would point towards the latter, as the few species possessing this modification are in other respects the most highly developed of this group.

The third segment, like the second, is truncate at its apex, while the fourth, fifth and sixth segments are prolonged laterally at the apex. There is a gradual increase in size in these segments, otherwise their structures closely resemble each other. In each, the notum and pleura are fused, but the sternum is a separate plate. On the pleura are laterally impressed lines converging toward the base. The sternal plates of these segments are separated by a mid-ventral longitudinal groove. On either side of this groove is a small projection, the tips of which point toward each other. The size and position of these projections vary in different genera. This character is used for generic classification.

In the female the last three segments of the abdomen are highly specialized. Ventrally they are plow-share shaped. The seventh is the deepest segment of the abdomen. Its ventral plate, however, is very small. Between the dorsal portions of the seventh and eighth segments is the membrane used by the female for coiling up the ovipositor, before thrusting it into the tree in which she desires to oviposit. The ovipositor becomes external on the ventral side between the seventh and eighth segments. It is long and slender, varying in length; in some species attaining a length of five or six inches and is always longer than the body of the insect. It is composed of three lateral sections which interlock. The ventral plates of the eighth

and ninth segments are for the most part membranous. The base of the sheaths of the ovipositor arises in these ventral plates and extends thus nearly to the apex of the abdomen. Near the apex comes a decided break where the sheaths proper are articulated. These are long and slender, equalling the ovipositor in length. They are concaved inwardly and convex with ridged rings outwardly. The nota of the eighth and ninth segments are small, but their pleura extend backward and are overlapped and partially concealed by those of the seventh segment. On the apex of the ninth segment is a small, blunt, rod-like projection, and beneath on either side of the groove which receives the sheaths is a small cercus. Both of these parts are probably tactile in their nature.

Sex Distinction

The presence or absence of the ovipositor and its sheaths is the most readily noticed sex distinction, but there are others not so easily noticed. The sternal plates of the female are longitudinally divided and the small projections described above are usually present, while in the males, the sternal plates are entire and the projections are absent. The abdomen of the female increases in size towards its apex while that of the male is long, slender, and approximately of the same width throughout. The small rod-like projections on the ninth segment of the female are, of course, lacking in the male, their positions being occupied by the male external genital organ. The ventral cerci of the female are absent in the male but the male has a pair of small cerci on the dorsal apex of the eighth segment which are not found in the female.

CLASSIFICATION

Tribe **Pimplini**

Ashmead, Proc. Ent. Soc. Wash., iii, p. 278, (1895).

Schmiedeknecht, Genera Insectorum, 62nd fascicle, p. 18, (1907).

On May 3, 1895, Ashmead read a paper before the Entomological Society of Washington, which was later published in the Proceedings of that society, in which he proposed the breaking up of the sub-family *Pimplinae* into a number of tribes, one of which was to be called *Pimplini*.

The following synoptic table leading to the tribe *Pimplini* is taken from the 62nd fascicle of the *Genera Insectorum*.

1. Head more or less cubical, more rarely globular. Mandibles extended, and with the clypeus downwardly bent at the tip, as a rule, forming the mouth opening. Antennae and legs mostly long and thin, Tribe **Xoridini**
Head transverse, rarely somewhat elevated. Mandibles with the clypeus forming no apparent mouth opening.....2
2. Abdomen depressed, rarely somewhat compressed at the tip. The last abdominal segment not large. Hind legs, particularly, not the hind coxae, neither strikingly long nor stout. Antennae almost entirely long and slender.....3
Abdomen behind more or less laterally compressed. The last ventral segment, generally plow-share shaped and standing out, sometimes very large, lancet-shaped, very rarely small and transverse. Hind legs or at least hind coxae strongly lengthened and generally strongly thickened. Antennae more or less short and stout,.....
.....(Tribes not included in this paper)
3. Abdomen with more or less distinct impressions, mostly also strongly punctured. When smoother and without elevations, then segments 2 to 5 have deep impressed, oblique lines on both sides which converge toward the middle of the base.....Tribe **Pimplini**
Abdomen without, or with entirely indistinct impressions, and without coarse sculpturing, more or less smooth or finely punctured or leather-like..... Tribe **Lissonotini**

The characters of the tribe *Pimplini* are: Head transverse, rarely somewhat elevated. Abdomen depressed, only toward the end mostly compressed, with more or less distinct impressions or elevations, usually punctured, rarely smooth, if smooth alutaceous or coriaceous, always with lateral impressed lines on segments 2 to 5 which converge toward the middle of the base. Mandibles with front border of clypeus not forming a mouth-opening. Hind legs not conspicuously lengthened and thickened.

SYNOPTIC TABLE TO GENERA HERE TREATED

Females

1. Mesonotum transversely rugose2
Mesonotum not transversely rugose.....(Genera not treated.)
2. Head with carina between the antennae.....**Apechoneura**
Head with a carina between the antennae.....3
3. Sternal plates of abdomen entire.....**Pseudorhyssa**
Sternal plates of abdomen divided by a median-longitudinal groove.....4

4. Projections along groove of the sternal plate nearer the base of each segment than its apex..... **Megarhyssa**
 Projections on sternal plate situated about mid-way between base and apex of each segment..... **Rhyssa**

Males

1. Propodeum areolated: head without a carina between the antennae..... **Pseudorhyssa**
 Propodeum not areolated..... 2
 2. Pleura and sternum of second abdominal segment fused for a short distance **Megarhyssa**
 Pleura and sternum of second abdominal segment not fused **Rhyssa**

Genus **MEGARHYSSA** Ashmead

Thalessa Holmgren, Öfvers. Svensk. Vet.-Akad. Förh., xvi, 1859, p. 132.

Megarhyssa Ashmead, Can. Ent., xxxii, 1900, p. 369.

Megarhyssa Dalla Torre, Cat. Hym., iii, 1901-2, p. 479.

Thalessa Schmiedeknecht, Gen. Ins. Fasc. 62, 1907, p. 63.

Genotype: (*Ichneumon clavator* Fabricius). [Sic]= (*Ichneumon*) *Megarhyssa clavatus* (Fabricius)= (*Ichneumon*) *Megarhyssa Superbus* (Schränk). (Vide Viereck, Proc. U. S. Nat. Mus., Bull. 83, p. 144, (1914).)

In *Megarhyssa* the clypeus is usually anteriorly truncate, the abdominal segments in the male are smooth, with segments 3 to 7 at the apex emarginate or deeply excavated. The sternal plate of the second abdominal segment is for a greater or lesser distance fused with the pleura at its anterior end. The amount of fusion varies with the species. The sternal plate of this segment is largely membranous, the chitin being apparently degenerated. Between the seventh and eighth segments, issues the membrane used by the female in ovipositing, as already described. The projections of the sternal plates of segments 3 to 6, on either side of the mid-ventral groove are longer than in *Rhyssa*, and are situated nearer the base than the apex of each segment.

Table to Females

1. Insects black or mostly black..... 2
 Insects yellow or yellowish red..... 4
 2. Black with white spots on the abdomen **humida** (Say) (p. 126)
 Black without white spots on the abdomen 3
 3. Ovipositor at least twice as long as the body..... **atrata** (Fabr.) (p. 128)
 Ovipositor not twice as long as the body..... **canadensis** (Cress.) (p. 129)
 4. Areolet in fore-wings absent..... **mexicana** (Cress.) (p. 131)
 Areolet in fore-wings present 5

5. Rounded spots on the sides of the abdomen... **nortonii** (Cress.) (p. 131)
No rounded spots on the sides of the abdomen.....6
6. Yellow band behind the eyes bordered posteriorly with a black band.
In second abdominal segment, pleura and sternum fused as far as or
but slightly beyond the spiracles, wings clouded at their tips.....
..... **lunator** (Fabr.) (p. 133)
- Yellow band behind the eyes not bordered posteriorly with a black band.
Fusion of pleura and sternum extending twice the distance from base
of segment to spiracles, wings not clouded at tips. **greenei** (Vier.) (p. 136)

Table to Males

1. Black or mostly black.....2
Not black.....3
2. Abdomen with white spots on its sides..... **nitida** (Cress.) (p. 137)
Abdomen without white spots on its sides.... **canadensis** (Cress.) (p. 129)
3. Recurrent nervure interstitial with outer transverse cubital
..... **nortonii** (Cress.) (p. 131)
Recurrent nervure not interstitial.....4
4. Wings fuscous..... **atrata** (Fabr.) (p. 128)
Wings not fuscous.....5
5. Yellow behind the eyes bordered by a black band extending around the
head nearly to the mandibles, wings clouded at tips.....
..... **lunator** (Fabr.) (p. 133)
Yellow behind the eyes merging into a light brown band, wings not clouded
at tips..... **greenei** (Vier.) (p. 136)

Megarhyssa humida (Say)

Pimpla humida Say, Boston Journ. Nat. Hist., i, pt. 3, 1836, p. 224, n. 1, ♀.

Pimpla humida LeConte, Writings of Thos. Say, ii, 1859, p. 683.

Rhyssa humida Dalla Torre, Cat. Hym., iii, 1901-2, p. 483.

Type. As this species was named by Say, the type cannot be located.

The female of this species is about half an inch long with an ovipositor slightly longer than the body. The head is yellowish-white with the vertex and a broad central band extending to the base of the insertion of the antennae dark, as is also the clypeus. There is a large dark spot in the middle of the lower margin of the frons from which a dark band extends to the antennae. The mandibles are black but the palpi are white. The antennae are brownish-black.

A broad yellowish-white band extends forward along the upper border of the prothorax from the tegula nearly to the middle line in front and downward at its posterior end, making the spot somewhat L-shaped. Beneath this band is a broad dark band running parallel to it, which occupies almost all of the remaining portion of the prothorax. Just below this dark band and above the procoxa is a pale rufous streak. The prosternum is pale rufous. The mesonotum is dark as is the prescutum. This dark color from the prescutum

extends backward between two parallel, longitudinal, yellowish-white bands on the mesonotum to the mesoscutellum. The center of the mesoscutellum has a square yellowish-white spot on it, and is interrupted at its front margin by a dark one. The posterior margin of the entire plate has a narrow white line, the remainder of the plate is black. On the metascutellum (generally called postscutellum) is an oblong yellowish-white spot. Both front and rear margins of this plate have a yellowish-white line, each side is black and a black line crosses from one side to the other just in front of the oblong spot. The mesosternum and metasternum as well as their pleura are pale rufous. The tegula, a raised spot beneath the fore wing and another spot below this are yellowish-white. The notum of the propodeum is dark with a yellowish-white spot separating it from the rufous pleura at its posterior end. The legs are pale rufous, with the knees, tibiae and tarsi whitish. The exterior surface of the middle tibiae and tarsi as well as the tarsal tips and sutures are darker. In the posterior tibiae the outer extremity is darkened and the tarsal segments become darker toward the tarsal claws, which are brownish-black. The wings are hyaline with dark brown nervures. The stigma is pale fuscous at its base but becomes darker towards its apex. The arcole is petiolated and the recurrent nervure enters it in the middle.

The abdomen is dark brown, polished and transversely aciculated above, and obliquely aciculated at the sides. On the notum of the second segment is a broad, dorsal depression extending from the base nearly to its tip. On the third, fourth, fifth, sixth, seventh and eighth segments are roundish, yellowish-white spots, which on the last two segments become elongated, with their axis at right angles to that of the body. The venter is yellowish-white with brown bands. The ovipositor is of a reddish-brown with darker colored sheaths.

Male unknown.

Megarhyssa humida is more apt to be confused with *Rhyssa persuasoria* than with any other species, yet an examination of the sternal plates will show a marked difference. The fact that the pleura and sternum of the second abdominal segment are fused for a short distance will serve to distinguish it from *Rhyssa persuasoria*. The fact that the mesosternum and metasternum of *M. humida* are rufous and not black is another distinguishing character. It can be distinguished from *M. atrata* by the absence of the yellowish-white markings found on the latter. It can be distinguished from *Megarhyssa nortonii*, *canadensis*, *lunator*, *greeni*, and *mexicana* by the presence of its yellowish-white orbits.

This species was described by Say as *Pimpla humida* and was later put into the genus *Rhyssa* by Walsh, but the structural characters of the sternal plates, the fusion of the pleura and sternum of the second abdominal segment, the ends of the

abdominal segments being acute instead of truncate, would seem to place it in *Megarhyssa*. It would also seem that this might be the female of *M. nitida* on account of the similarity of color-markings, size, and its petiolated areolet. If this should prove true the name *M. nitida* would fall into synonymy.

***Megarhyssa atrata* (Fabricius)**

Ichneumon atrata Fabricius, Spec. Insect., i, 1781, p. 436.

The following references are in addition to those given by Dalla Torre:

Lintner, Country Gentleman, July, 1883, p. 561.

Harrington, Can. Ent., xix, 1887, p. 206.

Riley, Insect Life, i, 1888-89, p. 168 et seq.

Smith, Insects of New Jersey, 1909, p. 627.

This species varies from about an inch to an inch and three-quarters in length, with a very long, dark-brown ovipositor, which in some cases attains a length of five or six inches. The head and antennae are yellow. The ocelli are embedded in a transverse dark band extending between the compound eyes. There is another transverse dark band at the point of insertion of the antennae, not quite reaching the compound eyes, and a black spot on the face just above the clypeus. The ground color of the thorax is a glossy black with a yellow spot in the prothorax just in front of the fore wing, one beneath the fore wing, and one on each side of the propodeum near where it articulates with the second abdominal segment. On each side of the mesoscutellum is a short, longitudinal dash, while in the center of the metascutellum (generally called post-scutellum) is a transverse yellow dash. The legs are yellow with the coxae, middle and hind trochanters, black and the fore-trochanters partly yellow. The procoxae each bear a more or less indistinguishable yellow spot. The middle and posterior femora are black with yellow tips. The tibiae are yellow, but the tarsal segments are darker at their outer extremities and the tips of the tarsal claws are black. The wings are fusco-hyaline and show an iridescence in some lights. The stigma is pale ferruginous at its base becoming darker toward its apex. The abdomen is brownish-black, some parts being slightly lighter than others.

M. atrata may be distinguished from *M. lunator*, *greenei*, and *mexicana* by its very dark abdomen. Its yellow antennae will distinguish it from *nitida*, *canadensis*, and *humida*. Its larger size would also serve to distinguish it as well as the length of the ovipositor, which is several times the length of the body.

Its life history is similar to that of *M. lunator* and *M. greenei* with which it is commonly found associated. The dates of capture of specimens seen range from June 2 to September 15.

The male of *M. atrata* differs from the female very markedly in its color markings. The structural sex differences are the same in *M. atrata* as in *M. lunator*. In general the male has

more yellow upon it than the female. The dark spot on the face just above the clypeus may or may not be present. The antennae are dark-brown but lighter beneath toward their tips. The upper margin of the prothorax is marked by yellow and this color may in some instances form a border around it, leaving a polished black spot in the center. Beneath the fore-wing is a raised yellow spot. Just below it and extending backward to the mesoepimeron and nearly down to the sternum is a yellow area. This area may be partly divided into two by a darker stain running through it. The prescutum is yellowish-brown and from it two bands of yellow or light brown pass backward over the mesonotum throughout its whole length, and it may be also more or less completely margined by the same color. A large yellow spot starts on each side of the metathorax at its upper margin and extends dorsally, covering the pleura of the propodeum and nearly meeting the other on the notum. Just before the hinder margin of the notum of the second and sometimes of the third abdominal segment is a narrow transverse yellow band. The rest of the abdomen is brownish-black, lighter in spots. *M. atrata* may be distinguished from *lunator* by the absence of clouded areas in the fore-wings, from *M. greeni* by its fusco-hyaline wings, and from *nortonii* by receiving the recurrent nervure in the middle of the areolet.

Megarhyssa canadensis (Cresson)

Hyssa canadensis Cresson, Can. Ent., i, 1885, p. 35, ♀.

Location of type.—In the collection of the American Entomological Society of Philadelphia.

The female of this species is about half an inch long with an ovipositor slightly longer than the body. The head is dark brown to black. The facial orbits are marked with a yellowish-white band interrupted at the point of insertion of the antennae and ending at the vertex. The posterior orbits in the lighter colored specimens are marked by a lighter brown. The palpi are whitish. The dark portion below the antennae is slightly raised medially and the whole is irregularly, transversely, striated. The antennae are dark brown becoming lighter and somewhat larger toward their tips.

The thorax is dark brown to black and its sides are clothed with numerous short, erect, whitish hairs. The tegulae are yellowish-white. The mesoscutellum and metascutellum (or postscutellum) are transversely striated. The sides of the thorax are highly polished and in the mesothorax are densely punctured. In the lighter specimens the prothorax is marked with a lighter

brown similar to that of the posterior orbits. In the lighter specimens the rear margin of the mesoscutellum, an oblong spot in the centre of the metascutellum and a line on its rear margin are rufous. In the darker specimens these plates show no color markings. The propodeum is transversely striated above, punctured below, with a median longitudinal depression extending nearly to its posterior margin. The wings are fusco-hyaline tinged with yellow, and slightly more fuscous nervures and stigma except at their base where they are lighter. The areolet is small, petiolated, with the recurrent nervure entering at its middle. The legs are pale rufous. The fifth segment of the anterior and middle tarsi, and the claws are dark. The posterior femur bears a dark spot at its extremity as does the tibia near its base. The tibia is darker along its external surface completely enveloping its outer half. The posterior tarsal segments are darker on their external surface, this dark color increasing towards the claws, which are all dark.

The abdomen is dark brown to black, transversely aciculated above, these aciculations bending forward at the sides. The ovipositor is dark brown with darker sheaths.

The male of this species, from the collection of the U. S. National Museum (here described for the first time), is slightly less than half an inch long. The head is black. The antennae are black at their base but become lighter and somewhat larger toward their tips. From the base of the antennae down to the clypeus the face is yellowish-white. This spot is prolonged to the vertex in the form of bands margining the compound eyes.

The thorax is black and polished. The sides of the mesothorax and metathorax are densely punctured. The mesoscutellum and metascutellum are transversely striated. The propodeum is transversely striated except along the median, longitudinal depression, which extends nearly to its posterior margin. Its sides are punctured. Numerous short, erect, whitish hairs clothe the thorax.

The wings, legs and abdomen are as in the female.

In size and general appearance *M. canadensis* resembles *humida* more closely than the other *Megarhyssae* but the absence of white spots on the side of the abdomen would serve to distinguish it from *humida* as well as from *atrata*. Its dark brown to black color with whitish color markings would distinguish it from *lunator*, *greenci*, *nortonii* and *mexicana*.

This species was originally described by Cresson as *Rhyssa canadensis*, but the structure of its sternal plates, the fusion of the pleura and sternum of the second abdominal segment, and the acutely angled tip of the abdominal segments would seem to place it in *Megarhyssa*.

Megarhyssa mexicana (Cresson)

Epirhyssa mexicana Cresson, Proc. Acad. Nat. Sci. Phila., 1893, p. 394, ♀.

No statement about the types accompanies the description, but a range in length measurement implies that more than one specimen was examined and there are two specimens labeled, "Type No. 599," from Mexico, in the collection of the American Entomological Society of Philadelphia.

♀. This species is about an inch long, with an ovipositor a little longer than the body. The head is yellow but the mandibles are black. The region in which the ocelli are imbedded and extending between the compound eyes is slightly darker than the ground color of the head. Parallel and posterior to this darkened area is a dark band which nearly encircles the head. The suture from the compound eyes to the mandibles and extending across the upper part of the clypeus is also dark. The antennae are dark brown, except the under side of the scape which is lighter colored than the flagellum.

The ground color of the thorax is pale yellow. The sutures separating the mesonotum from the prescutum, prothorax and mesoscutellum are dark. A dark band runs along the center of the prescutum and another on each side of the mesonotum runs from the prescutum back to the mesoscutellum. The suture separating the mesothorax from the metathorax and the propodeum is also dark. The legs are yellow and the tarsi become darker toward the tarsal claws which are dark brown or black. The suture dividing the posterior femur from its trochanter is dark. The wings are faintly yellow-hyaline, clouded at their tips and without an areolet in the specimens examined.

The abdomen is yellow, smooth, and glistening. The tips of the second, third, fourth, fifth and sixth segments are each bordered with a black band. In the remaining segments these bands are nearly obsolete. The ovipositor is dark brown.

Male unknown.

Distinguishing characters.—*Mexicana* may be distinguished from the other species of *Megarhyssa* by its yellow abdomen without spots and probably by the absence of the areolet in its fore wings.

This species was placed in *Epirhyssa* by Cresson, but the structure of its sternal plates agrees with those of *Megarhyssa* and the presence of the areolet seems to be a variable character in this group.

Megarhyssa nortonii (Cresson)

Rhyssa nortonii Cresson, Proc. Ent. Soc. Phila., iii, p. 317, ♀.

Thalessa quebecensis Provancher, Natural Canad., v, 1873, p. 317, ♀ ♂.

Thalessa nortonii Provancher, Faun. Ent. Canad.; Hymen., 1883, p. 445.

Type.—In the collection of the American Entomological Society of Philadelphia.

The female of this species varies from about an inch to an inch and a half in length, with an ovipositor about twice the length of the body. The head is yellow, marked with dark-brown or black. There is a dark band extending across the upper part of the head between the front margins of the compound eyes, in which the ocelli are embedded. From this dark band back to the occiput extends a dark brown to black area, slightly lighter in color than the transverse band. From the latter, a dark band extends down to the labrum, where it broadens out, extending to the lower margins of the compound eyes, and thence downward covering all of the lower part of the head in front. The antennae are dark brown to black with the scape and pedicel more glistering than the flagellum. The ground color of the thorax varies from brown to black. There is a yellow spot on the side of the prothorax, another beneath the wing, on the side of the metathorax, and on the propodeum just above. In the lighter specimens these propodeal spots may be confluent over the dorsum. The mesonotum may be brown with black markings, black with ferruginous markings, or entirely black. The mesoseutellum has a square yellow spot in its center and the metaseutellum (generally called postscutellum) has an oblong yellow spot. The wings are hyaline, tinged with yellow, giving a faint violet reflection in some lights. The stigma is pale-ferruginous. The legs are yellow varying with darker shades of the same color. The coxae vary from dark brown to black. The middle and posterior femora are dark with their tips yellow, as are also the tibiae. The tips of the tarsal claws are black. The abdomen is slightly lighter in color than the thorax. Just before the hinder margin of the notum of the second and also of the third abdominal segments is a small transverse yellow band. In the darker colored specimens, reddish-yellow spots are found on the sides of the segments. The spots on the anterior portion of the abdomen are about in the middle of each segment, but they gradually move forward, so that in the posterior segments they are found on the anterior margins. In the lighter colored specimens they are not distinct and form spots only a little lighter than their surroundings. On each side of the fourth, fifth, sixth, seventh, and eighth segments is a yellow spot, more or less oval in form. The long axis of the spot on the last two segments is nearly at right angles to the body axis.

In *M. nortonii* the yellow spots on the sides of the abdomen are rounded-oval, while in the closely related *M. lunator* and *M. greeni* they form angled bands. In *M. nortonii* there is a dark stripe extending from the vertex to and including the mandibles, in *M. lunator* there are two dark lines running from the antennae to the mandibles, and in *M. greeni* these lines are absent. *M. nortonii* can be distinguished from *M. mexicana* in that the latter has a pale-yellow ground color, with black markings on the abdomen. The wings of the latter are clouded

at the tips, and possess no areolet, neither are there any dark markings on the face. *M. nortonii* may be distinguished from *M. atrata*, *humida*, *canadensis* and *nitida* by the fact that in these latter forms the greater part of the surface of the body is black, with white, yellow, or fuscous body markings.

Megarhyssa nortonii is widely distributed throughout the United States, Canada, and Alaska. Specimens taken from the Pacific coast ranging from Alaska down through California, exhibit in general much darker color markings than those taken east of the Rocky Mountains.

Provancher described *M. nortonii* as *Thalessa quebecensis* in 1873, but as he applied the identical description to *Thalessa nortonii* in 1883, it shows that he recognized that the two were identical. The dates of capture of specimens seen range from May 20 to Aug. 7.

Male. Not having seen what he would consider a bona-fide specimen of a male *nortonii*, the writer will use a translation of Provancher's description of a male.³

Male. Length one and one-tenth inches. Differ little from the female. The polished plaque of the two sides of the prothorax is without yellow spots. The metathorax is clearer towards its extremity, without spots on the sides and flanks are of a uniform, shiny red. Segments one and two have a yellow band towards the summit. The second segment is the same as that of the female, bordered with black at both ends and on the sides. The recurrent nervure is interstitial with the outer transverse cubital.

Megarhyssa lunator (Fabricius)

Ichneumon lunator Fabricius, Spec. Insect., i, 1781, p. 430, n. 64.

The following references are additions to the list given by Dalla Torre:

Lintner, Country Gentleman, July 1883, p. 561.

Harrington, Canadian Entomologist, xix, 1887, p. 206.

Riley, Insect Life, i, 1888-89, p. 168 et seq.

Smith, Insects of New Jersey, 1909, p. 627.

There seems to be no record of the present location of the type of this species.

♀. The individuals of this sex vary in length from three-quarters of an inch to an inch and a half, and the ovipositor from an inch and a half to three and three-quarters inches. The head is yellow with a transverse dark band on its vertex, in which are inserted the three ocelli. Another dark band behind the former and running parallel to it, almost encircles the head. A dark line runs from the base of each antenna to the labrum. The mandibles are dark brown, stout and bidentate. The antennae are dark brown and slender.

³Le Naturaliste Canadien, v, 1873, p. 445.

The ground color of the thorax and propodeum is yellow, varying somewhat in shade but generally rather light. The markings range from yellowish-brown to black and seem in some places to be situated on the margin of the sclerites to quite an extent. The ground color of the legs is yellow, like the thorax, becoming darker toward the tips. Spots and streaks of brown occur here and there.

The prescutum which is practically circular in outline is margined with brown or black, and from its hinder margin a band of this color extends to the hinder end of the mesoscutum and a broader band narrowing posteriorly, extends backward on either side. The ground color of the mesoscutum appears as a pair of longitudinal bands and a narrow margin above the tegula at each side.

In the fore wing there is a brown, sometimes almost blackish, area covering the stigma and extending backward across the radial cell, the tip of the cubito-discoidal cell and frequently more or less involving the areolet. The tip of the third submarginal cell is also covered by a spot of this kind, less pronounced, however, than the other.

The abdomen is brown, varying considerably in shade, with bands and lines of yellow. Just in front of the hinder margin of the notum of the second and also of the third segments is a transverse yellow band, slightly bent forward at its ends. These yellow bands in the lighter forms are margined with brown distinctly darker than that of the segments as a whole. In the darker form these margins are not in evidence. On the fourth, fifth and sixth segments, these bands are extended forward almost to the spiracles, then toward the hinder end and upward, following the general outline of the end of the segments, the two parts of the band forming an acute angle. These bands are not continuous across the dorsum, nor are the dark bands which margin them, but in the eighth segment the yellow band is continuous.

The fusion of the pleura with the sternum of the second abdominal segment extends from the base of that segment out to, or but slightly beyond the spiracles.

The male *lunator* differs from the female only in the following respects: the abdomen of the male is sub-cylindrical throughout and not plow-share shaped as, in the female. The pleura are extended downward completely enveloping the sterna of all but the second, third and a small portion of the fourth segments. The sterna are not longitudinally divided by a groove and therefore cannot show the median-sternal projections which may be seen in the female. There is more variation in the color markings of the male, some specimens showing a dark spot on the face above the clypeus: just before the apex of the second and also of the third abdominal segments is a short transverse yellow band, slightly notched at the center of its inner margin. These bands are the only color markings on the abdomen. This sex may be distinguished from the male *atrata* by the spotted wings, and from *nortonii* by the recurrent nervure entering at the middle of the areolet.

Distinguishing Characters.—*Lunator* may be distinguished from *greenei* by the following differences. It has dark lines from the base of the antennae to the labrum, a dark band parallel to the

one in which the ocelli are imbedded, dark patches on the tips of its wings, which characters are absent in *greenei*. In *lunator* the fusion of the pleura with the sternum of the second abdominal segment extends to or but slightly beyond the spiracle, while in *greenei* it extends as far beyond the spiracle as the distance between the spiracle and base of the segment. In *lunator* the dark bands on the abdominal segments are not continuous over the dorsum, while they are in *greenei*. On the eighth segment of *lunator* the yellow band is continuous but this condition does not occur in *greenei*. In *lunator* the ovipositors are relatively longer than in *greenei*, being from two to two and a half times the length of the body, and in *greenei* from one to one and a half times.

Lunator may be distinguished from *nortonii* by the shape of the markings on the 4th, 5th and 6th abdominal segments. In *lunator* they are acutely angulated bands, while in *nortonii* they are roundish spots. The wings of *lunator* are hyaline, with dark spots, while in *nortonii* they are transparent, fuscous and with no dark patches. It can be distinguished from *mexicana* in that the latter is bright yellow marked with black. The apical margins of the abdominal segments of *mexicana* are bordered with black bands continuous over the dorsum. The areolet of the fore wings of *mexicana* is absent. It also has a dark patch on the tip of the fore wing but none in the region of the stigma. *Mexicana* has no dark lines from the base of the antennae to the labrum.

Lunator may be distinguished from *atrata*, *humida*, *canadensis* and *nitida* by the fact that in these forms the greater part of the surface of the body is black with white, yellow or fuscous body markings.

This species is widely distributed throughout the United States and Canada. It is found in abundance on trees and logs which are infested with *Tremex*, working in company with *M. atrata* and *M. greenei*. They appear early in the summer and throughout the whole season may be seen crawling about, seeking a favorable spot for ovipositions. After laying its egg the insect is often unable to extricate its ovipositor and is held a prisoner by it until death. Mr. C. W. Johnson, Curator of the Boston Society of Natural History, observed a large number of males

massed together on a log in Maine. He attempted to capture them with his net, but they all flew away. Returning to the same spot later, he found the males again assembled there. This time he reached out and caught a number with his hand. Upon being examined they were found to be males of both *M. lunator* and *M. greeni*. The female, which later emerged, proved to be a specimen of *M. lunator*. Whether there was a female of *M. greeni* about to emerge near where the *M. lunator* came out, or whether the males are unable to know in advance, the species to which the emerging insect belongs, is a question.

The dates of capture of the specimens of this species which have come under my observation range from May 13 to September 30, although these are very probably not the outside limits.

Megarhyssa greeni Viereck

Megarhyssa greeni Viereck, Proc. U. S. Nat. Mus., xl, p. 191, ♀ ♂.

Smith, Insects of New Jersey, 1909, p. 627.

Viereck, Proc. Ent. Soc. Wash., xiii, no. 2, p. 96.

Type.—Cat. No. 13,499, U. S. N. M.

Type locality: Harrisburg, Pennsylvania; female, June 25, male, August 22, 1908.

Megarhyssa greeni agrees with *M. lunator* except in the following details. It has no dark lines extending from the base of the antennae to the labrum. The band parallel to the one in which the ocelli are imbedded, which in *M. lunator* is dark brown or black, in *M. greeni* is but slightly darker than the yellow ground color of the head. There is no dark patch on the tip of the wings. The fusion of the sternum and pleura extends about twice as far from the base of the second abdominal segment as it does in *M. lunator*, reaching as far beyond the spiracles as the distance from the base of the segment to the spiracles. On the abdomen, the black bands which border the yellow markings are continuous over the dorsum, but the yellow band on the eighth segment is not continuous. The ovipositors are relatively shorter, being only from one to one and a half times the length of the body.

The description of *M. lunator* applies to the male of *M. greeni* in all respects except those named above.

For characters distinguishing this species from others in the same genus, see list of distinguishing characters given after the description of *M. lunator*.

The dates of capture of specimens seen, range from June 2 to September 25.

The male of *M. greenei* differs from the female *greenei* in the same respects as found in *lunator*, although the color markings more closely resemble each other in the two sexes than in *lunator*. It may be distinguished from the male of *lunator* by the absence of the clouded spots in the wing.

Megarhyssa nitida (Cresson)

Rhyssa nitida Cresson, Proc. Ent. Soc. Phila., iii, p. 319, ♂.

Type.—There is one type specimen from Virginia, in the collection of the American Entomological Society of Philadelphia.

The male of this species is about half an inch long. The head is black. The antennae are dark, the scape is yellowish-white beneath, and the flagellum becomes lighter towards its tip. The mandibles are black but the palpi are yellowish-white. The clypeus is yellowish-white and this color extends upwards over the face, spreading to the compound eyes; to the base of the insertion of the antennae where it is interrupted, and sometimes to the vertex, as two yellowish-white bands margining the compound eyes. Behind the compound eyes are yellowish white bands, stopping just short of the mandibles and the vertex. The thorax is black. Beginning at the tegula a triangular shaped white band, which later becomes reduced to a line, passes forward along the upper border of the prothorax nearly to its middle line. A white streak appears just above the procoxa. The prescutum and mesonotum are black, the latter with a pair of fine longitudinal yellowish-white lines near its center. The center of the mesoscutellum has a large yellowish-white spot on it, nearly divided at its front margin by a dark one. The posterior margin of the entire plate has a narrow white line. On the metascutellum (postscutellum) is an oblong white spot. The rear margin of the plate bears a yellowish-white line. The tegulae and a raised spot beneath the fore wing are yellowish-white. The metapleurae are pale rufous. The wings are hyaline, iridescent, with fuscous nervures which are pale at their base. The stigma is fuscous except its base, which is pale. The arcolet is small and petiolated. The anterior legs are yellowish-white, on the outer side of the tibiae are slightly darker markings. The extremities of the tarsal segments are darker than their bases and the claws are dark. The middle coxae are pale rufous, the trochanters, femora, tibiae, and tarsi are yellowish-white. The tip and a spot at the base of the femora are dark. The extremities of the tarsal claws are much darker than in the anterior legs, the last four segments being almost completely dark, as are the tarsal claws. The posterior coxae are pale rufous, the trochanters are yellowish-white, with their extremities dark. The femora are rufous with a dark spot on their outer extremities. The tibiae are lighter but each has a dark spot on its extremity, and another fainter one near its base. The first two tarsal segments are yellowish-white, their tips dark, the third, fourth, and fifth are dark, the claws are rufous. The abdomen is black

and polished. On each side of the third segment is a small yellowish-white spot: similar spots are found on the remaining segments, increasing in size up to the fifth, after which they decrease.

♀ Unknown.

M. nitida may be distinguished from the rest of the *Megarhyssae* by means of its dark abdomen with the yellowish-white markings.

In all probability *M. nitida* is the male form of *M. humida* as previously stated.

Habits of Megarhyssa

The following extracts are taken from an article by C. V. Riley,⁹ because he gives the best description of the habits of *Megarhyssa*.

" . . . In preparing for the act (oviposition) the position is generally longitudinal or in a line with the axis of the trunk or branch, the head either up or down. With the abdomen raised in the air the ovipositor is taken and managed with the hind legs, and the tip guided by the front tarsi. The two outer sheaths are used as props and do not enter the wood with the ovipositor proper. They are generally crossed—a position which gives additional strength and security to them. Now, by a movement from side to side, and by arching the abdomen and bearing upon the ovipositor she gradually forces this back through the tip of the abdomen into a membrane which issues from between the sixth and seventh joints dorsally. There is a wonderful muscular power in the anal joints, and the ovipositor is forced back until it forms a perfect coil, so that when the abdomen is stretched in a straight line to its utmost the ovipositor within the membrane makes a circle almost as large as a quarter of a dollar, the anal joint having made a three-fourths turn within the membrane. In this manner the ovipositor under the venter has been sufficiently shortened to bring its tip against the bark. During this operation, however, the outer sheaths, which have not followed the ovipositor within the membrane, have been obliged to make a more or less irregular coil opposite to and in front of the membrane on the ventral side. Now commences the operation of boring, and with the wonderful muscular power in the anal joint and the elasticity of the membrane, the insertion of the ovipositor goes on quite steadily if the wood be in the

⁹ Insect Life, i, 1888-89, p. 168.

least soft. As the borer enters, the sheaths make a larger and larger loop on one side of the body, or even a valve on each side. . . . In withdrawing the ovipositor the reverse action takes place and the loops of the outer sheaths gradually become smaller and smaller; the ovipositor is again forced back into the tough bladder-like membrane between the sixth and seventh joints dorsally and we have a repetition of the appearance."

The old idea was that the *Megarhyssa* probed a burrow with her ovipositor until she came in contact with the larva of a *Tremex*, which she pierced and deposited an egg therein. The observation has also been made that the insect is lignivorous and not parasitic. Both of these conclusions have been shown to be false. Riley quotes J. A. Lintner,¹⁰ as follows:

" . . . In all instances where I have found the female depositing, it has been in trees infested with *Tremex columba*, and I have found her more numerous on badly affected or injured trees, or even on stumps or broken trunks already partly decayed. The instinct to reach the egg or larva of *Tremex*, so dwelt upon in popular accounts, is imaginary. She bores directly through the outer parts of the tree, and doubtless probes for a burrow; but her egg is consigned anywhere in the burrow; the young larva seeks its prey, and lives and develops without penetrating the body of its victim, but fastened to the exterior. This habit among parasites is much more common than is generally supposed. A great many *Rhyssa* (i. e. *Megarhyssa*) larvae doubtless perish without finding food, and a great many females die in probing for a burrow, especially when they burrow through wood that is sound and hard."

In this same paper, Riley in speaking of some personal observations, says, ". . . We examined the burrows very carefully and found *Thalessa* (i. e. *Megarhyssa*) in all stages at that time—larvae, pupae of both sexes, and imagines of both sexes within the tree—the larvae being of various sizes and invariably external to the *Tremex*: i. e. not within, but holding on to its victim and sucking the latter's life away, without in any case entering the body."

The insect remains within the tree until it becomes adult, then it gnaws its way to the surface and escapes. The males usually

¹⁰ Country Gentleman, xlix, 1884, p. 331.

appear first. W. H. Harrington¹¹ has given a series of observations made in June, 1887, in which he showed that the males having issued first, awaited the females, and were able to locate the spot at which a given female would emerge, some time before she made her appearance. In one instance which he records, a particular spot was crowded with males for two days before the female emerged, and even then, she was assisted by the removal of the bark by the observer. The males, in waiting, make every effort to reach the female, inserting the tips of their abdomen into crevices in the bark. On emerging the female is instantly seized, the legs of the male clasping the yet unused wings and abdomen, thus preventing her from flying.

Genus **RHYSSA** Gravenhorst

Rhyssa Gravenhorst, Ichneum. Europ., iii, 1829, p. 260.

Epirhyssa Cresson, Proc. Ent. Soc. Phila., iv, 1865, p. 39.

Pararhyssa Walsh, Trans. Acad. Sci. St. Louis, v, 1873, p. 109.

Rhyssa Riley, Ins. Life, i, 1888-9, p. 169 (habits).

Rhyssa Dalla Torre, Cat. Hym., iii, 1901-2, p. 482.

Epirhyssa Schmiedeknecht, Gen. Ins., fasc. 62, 1907, p. 59.

Rhyssa Schmiedeknecht, Gen. Ins., fasc. 62, 1907, p. 62.

Rhyssa Ramsey, The Entom., xlvii, 1914, p. 20 (habits).

Genotype: *Ichneumon persuasorius* Linn.

Rhyssa, a primitive and widespread genus, occurs both in America and Europe. In North America it is found from Alaska to Mexico and from the Pacific to the Atlantic coast, and is also found on the island of Cuba. There are two records of fossil *Rhyssae* being found, one in the Lower Miocene and the other in the Oligocene.¹² It occurs under such a variety of climates and conditions that considerable variation both in color and structural characters is found. It would seem as though it were trying to break up into a number of races and thence to species, but its variations have not become fixed to such an extent that they may be considered as permanent. *Rhyssa persuasoria*, the oldest described species of this genus, was described by Linnaeus; since there have been several new species described, in some instances from a single specimen, but the amount of variation is so great that it does not seem safe to accept as a new species, one described from a single specimen.

¹¹ Can. Ent. xix, 1887, p. 206.

¹² Scudder, Tert. Insect. t. 10, 1890, p. 19.

In 1864, Cresson described *Rhyssa albomaculata*. He separated this species from *R. persuasoria* on the grounds that the former had a white band on its antennae, a slight difference in color markings and a small petiolated areolet, but as specimens occur with white banded antennae and areolets similar to those with black antennae and vice versa, and as there is a great range in both thoracic and abdominal markings which do not adhere always to the antennal or areolet differences, it would seem that *R. albomaculata* is really *R. persuasoria*. *R. skinneri* Viereck is described from one specimen, mainly upon structural characters, with some difference in color markings, but in *R. persuasoria* there is a marked variability in structural as well as in color markings. The clypeus may range from pointed to truncate, the face may be medially elevated and smooth or striated or the whole face may be elevated. There is considerable variation in the puncturing and rugulose characters of the thorax. The notum of the propodeum may or may not have a medial-longitudinal depression. As for the differences in color it would seem that no dependence could be placed upon them, and that *Rhyssa skinneri* will probably prove to be a synonym. *Rhyssa alaskensis* was described by Ashmead from one specimen. The description of this species will apply equally well to *Rhyssa persuasoria* and it will probably prove to belong to the latter species.

Table to Species of Rhyssa

1. Face elevation longitudinally rugulose..... **skinneri** Viereck
2. Face elevation not longitudinally rugulose..... **persuasoria** Linnaeus

Rhyssa skinneri Viereck

Rhyssa skinneri Viereck, Trans. Am. Ent. Soc., xxix, 1903, p. 87, ♀.

Type.—In collection of Acad. of Nat. Sci. Phila., from Beulah, New Mexico, Aug. 17, 1901, (H. Skinner).

"Face rugulose; mesonotum almost uniformly transversely striate, the striae not apparently gibbose. Raised line separating metanotum and pleura poorly defined, being obsolete below the spiracles. Length, 23 mm., face somewhat elevated medially, the elevation rather longitudinally rugulose, sides and anterior margins of the face, polished and moderately sparsely punctured. Clypeus highly polished, distinctly produced to a point medially, and with a row of deep punctures. Cheeks polished, almost impunctate. Dorsulum transversely striate, the striae delicate but well defined posteriorly.

Carina on anterior half of mesopleura becoming indistinct half way upon the pleura, strongly striato-punctate, the superior half, highly polished. Scutellum flattened, transversely striate. Metanotum with a slight median longitudinal impression, delicately, transversely sculptured, laterally shining, rugulose; metapleura polished, sparsely punctured, rugulose on the superior margin. Wings hyaline, with a brown cast, nervures and stigma dark brown, second recurrent nervure interstitial with the second transverse cubitus. Dorsal abdominal segments finely transversely sculptured, having a satiny luster. Ovipositor about 29 mm. in length. Black, a line from malar space to apex of the eye, a band on the superior border of the propleurae, a spot below on the tubercle, a spot on the anterior coxae, greater part of the tegulae, a large spot beneath, a small spot on the mesopleurae, a spot on the medial coxae, a short line to the sides and apex of first, second, third, fourth, fifth and sixth, and a lateral line on the seventh dorsal segments, white. Greater part of four anterior legs (excluding coxae) ochraceous. Apex of first, all of second trochanters and the femora of posterior legs ferruginous; the tibiae and tarsi dark brown. Described from one female specimen "closely related to *R. persuasoria* but distinguished by the difference in sculpture, very distinct in coloration."

As the writer has never seen the type of this species, the original description by Viereck is here given.

***Rhyssa persuasoria* (Linnaeus)**

Ichneumon persuasoria Linnaeus, Syst. Nat., Ed. x, 1758, p. 256, n. 67.

Cryptocentrum lineolatum Kirby, Fauna Bor. Amer., iv, 1837, p. 260.

Rhyssa albomaculata Cresson, Proc. Ent. Soc. Phila., iii, 1864, p. 318.

Rhyssa (Pararhyssa) albimaculata Walsh, Trans. Acad. St. Louis, iii, 1873, p. 109.

Cryptocentrum lineolatum Kirby, Can. Ent., ix, 1877, p. 150.

Epirhyssa crevieri Provancher, Nat. Canad., xii, 1880, p. 17.

Rhyssa persuasoria Riley, Insect Life, i, 1888-89, p. 169.

Rhyssa albomaculata Hopkins, Bull. 32, West Va. Exp. Sta., 1893, p. 217.

Rhyssa persuasoria Morley, The Entomologist, xlii, 1909, p. 133, note.

Rhyssa persuasoria Morley, The Entomologist, xliii, 1910, p. 243.

Rhyssa alaskensis Ashmead, Harr. Alaska Exp., ix, 1910, p. 205.

Type.—Location unknown. Type of *Cryptocentrum lineolatum* in British Museum.

The female of this species is from about half an inch to nearly an inch in length. Its color markings are also very variable. The head is dark brown to black. In most instances the orbits of the compound eyes are white, rarely interrupted at the vertex, and extending downward as far as the clypeus on each side of the eye. In some specimens there is a white band just above the clypeus connecting the lower ends of the bands of the facial orbits, in others the lower part of the face below the antennae and above the clypeus is white. The clypeus may be pointed or vary toward truncate. Below the antennae the face may be raised centrally or entirely, and its surface may be

smooth or striated. The antennae are dark brown to black. Some are all black, some have a suggestion of white, some one or two segments that are white, while in others there may be a number of distinct, white segments forming a band on the antennae. The individuals having this last-named characteristic have been regarded by some as forming a separate species, *Rhyssa albomaculata*.

The thorax is dark brown to black. There is a variable amount of thoracic punctures and striations. The prothorax is bordered above and below with a varying amount of white. In some the sides of the prothorax have such an amount of white that the dark ground color only shows as a spot in the center. The mesonotum is immaculate. On the center of the mesoscutellum is a square white spot, and usually there is a white line on the rear margin of the entire plate. There is an oblong white spot on the center of the metascutellum (postscutellum) and this plate may or may not have its rear margin marked by a white line. The tegulae and a raised spot beneath the fore wings are always white. On the mesopleuron just below the attachment of hind wing is a white spot and another just above and in front of the middle coxae. The size of these spots is variable and they may even coalesce, margining the posterior border of the mesopleuron. There is a variable white spot on the side of the metathorax and another just above it on the propodeum. In some specimens there is a median longitudinal depression on the notum of the propodeum; in others it is suggested, while in some it is absent. The wings are hyaline sometimes tinged with yellow. The nervures and stigma are fuscous except at their base, where they are paler. The shape, size, and even the presence of the areolet are variable. The recurrent nervure is usually interstitial with the outer transverse cubital nervure. In some the latter nervure is present and assists in forming the areolet, in others but a stub of it remains while in some cases it is absent. In some cases the areolet is petiolated, receiving the recurrent nervure in its middle. The legs vary from light yellow to rufous, the coxae from white to black with white spots. In general the posterior legs are darker than the others. The color is even more variable in the legs than in the thorax. The abdomen is dark brown to black, lustrous, and finely, transversely aciculated above. The lower borders of the pleura of the second segment are each margined with a white band, which bends upward at its posterior margin and usually meets its fellow of the opposite side, above. The third segment is similarly marked except that the bands do not quite meet above. Usually on the fourth, fifth, sixth, and seventh segments these bands are interrupted so that a spot is formed on the upper side of the pleuron, while its lower border remains marked with a white band. In some, the spot and band are connected on the seventh segment. On the last segment the white marking is continuous along the posterior margin but does not meet its fellow above. This line is not always continuous. The ovipositor is slightly longer than the body, dark brown to black, with darker colored sheaths.

The male differs from the female in that the face below the antennae is whiter and the anterior coxae and femora are lighter colored.

I have not seen the type of *Rhyssa skinneri* Viereck, as already stated, but from the description, it does not seem impossible that it may be a form of this species.

Habits of Rhyssa

The *Rhyssae* by means of their ovipositors bore into trees infested with borers and there deposit their eggs. They are primary parasites on *Sirex*, *Monohammus* and *Urocerus cyaneus*. As their life from hatching to adult is spent within the trunks of trees, it has made a study of their history practically impossible. It has been generally assumed that they were external parasites, but H. J. Erne¹³ gives an account of raising *Rhyssa* from *Sirex*. According to him the eggs were laid within the larvae. It has been clearly shown that in the closely related genus *Megarhyssa*, the eggs are external to the larvae. The tip of the ovipositor is constructed for sawing into wood and not for piercing other insects. It does not seem probable that the members of one genus live as external while those of so similar a genus should live as internal parasites. Yet the only published evidence that has been found asserts that *Rhyssa* live as internal parasites. Erne's observations will be given here though their accuracy is doubted.

"In studying *Serropalpus* I had an opportunity to observe *Pimpla persuasoria*. The eggs of *Pimpla* were usually laid in the larva of a species of *Sirex*, which were very inactive on that account, and did not put up any resistance. After they hatched the little larva remained in the *Sirex* larva until the latter died. The larva of *Pimpla* had by this time attained a size of two or three lines.

"They left the *Sirex* larva after it was dead, and from time to time fed on the remains. If the *Sirex* larva is large the *Pimpla* larva has food enough, but if it is small, the food supply is not sufficient, and since the *Pimpla* does not try any other nourishment it dies in the wood. Frequently the *Sirex* larva with the parasite larva in its body, penetrates deeply into the wood, so that the developed *Pimpla* has to bite its way out of the wood from a depth of two lines in order to get free. For a space of three days it thus works itself forward; if it does not get free in three days its strength becomes weakened and it dies in the

¹³ Mittheil. Schweiz. Entom. Gesell., iv, 1876, p. 9, p. 518.

wood. If one would rear the larva of a *Pimpla persuasoria*, one must give it the remains of the same larva for nourishment in which it was hatched."

Riley says¹⁴ that Ratzeburg states that both Nordlinger and himself raised *Rhyssa persuasoria* from *Sirex spectrum*, but does not give any details of his observations nor does he state that the parasite in ovipositing pierces the wood-boring grub.

The subject of the habits of *Rhyssa* is by no means a clear one, and it awaits some worker who will be fortunate enough to observe its complete life history.

The genus *Rhyssa* Gravenhorst, has its clypeus medially lengthened or unidentate and its abdominal segments rounded at the apices. The sternal plate of the second abdominal segment is not fused with the pleura. The projections of the sternal plates on either side of the mid-ventral groove are placed about mid-way between the base and apex of each segment. The sternal plate of the second abdominal segment is composed almost wholly of chitin. The ovipositors of *Rhyssa* are but little longer than the body, consequently they do not need the membrane which is used by *Megarhyssa* in forcing its long ovipositor into the wood.

Since the above was written an article has appeared on the habits of oviposition by *Rhyssa* by L. N. G. Ramsay,¹⁵ as follows:

"The remarkable insects of the genus *Rhyssa* have for long been known to prey on the wood-boring larvae of *Siricidae*, introducing their eggs into the tunnels of the latter by means of their enormously elongated ovipositor. The ovipositor is sometimes even found sticking in a *Sirex*-infested log (as, for example, the specimens exhibited in the insect gallery at South Kensington), but, I understand, the manner in which the insect contrives to insert this unwieldy appliance into the tree-trunk has not hitherto been fully described. I hope, therefore, that the following account may be of interest to entomologists.

"The event described was witnessed in the summer of 1909, while I was staying in the southern part of the Black Forest, to the west of the Wehratal. On the afternoon of August 29th,

¹⁴ Insect Life, i, 1888-89, p. 169.

¹⁵ The Entomologist, xlvii, p. 20, f. 14, (1914).

while skirting a wood—the very finest conifers of the Black Forest flourish in this locality—I happened to pause beside a pile of small pine logs, and as I stood there one of these extraordinary insects appeared and settled on one of the logs. I will quote verbatim from my notes written the same day:—‘It sat still for some time, and then began to walk about, feeling every hole and (p. 21) corner in the rough bark with its long antennae. After a minute or two of this it stopped, and drew up its long body, doubling the long black ovipositor underneath itself; it had to hitch itself up several times before it got the long needle into position underneath, with the tip in a crevice. Then it gripped the bark with its claws and gradually thrust the ovipositor about half an inch into the bark, then suddenly flew away, perhaps because it had completed laying the eggs, perhaps because I had gone too close. . . .

“Immediately after, I made the rough sketches of the beast which accompany this note. These are probably a little larger than life, although the insect was a very large one. I noted that the abdomen was black and white, the legs pale, and the antennae black.

“At the time I was unaware of the insect’s identity, but on seeing the specimens of *Rhyssa* exhibited at the Natural History Museum this year, I at once recognized my old acquaintance, and comparison of the other species of the genus in the cabinet collections there leaves little, if any doubt, that this was *R. persuasoria*.

“The figures will help to indicate the manner in which the insect succeeded in bringing its unwieldy ovipositor to bear on the log. As mentioned above, these were drawn before I left the spot (with the exception of the second, which I have added now to make the action clearer), and they are reproduced without any change from my original rough drawings. As the insect had already taken its departure, they are necessarily crude, as it was the only example of its kind on which I had ever set eyes. For this and for their obvious artistic defects I shall make no further apology, as they are merely intended to convey the manner in which the insect accomplished its object.”

Sharp¹⁶ figures (after Riley) the allied genus *Thalessa* (now

¹⁶ Cambridge Natural History, Insects, pt. i, p. 554, 1895.

Megarhyssa) in the act of oviposition, and states that in both these genera the ovipositor is "brought into use by being bent on itself over the back of the insect, so as to bring the tip vertically down onto the wood, through which it is then forced by a series of efforts; the sheaths do not enter the wood."

It is evident that this description does not tally with the foregoing observations on *Rhyssa*. The insect figured by Sharp follows his statements in having its long ovipositor bent on itself, out of its normal and approximately straight form, into an almost complete circle. From purely physical considerations, is it not a little difficult to understand how a non-muscular structure could be curved at will in this way? The possibility suggests itself to the present writer that the insect there figured, after having inserted its ovipositor in the manner described in this note for *Rhyssa*, may have pivoted its body through an angle of 180° around the flexible fixed ovipositor, in its efforts to thrust the latter into an unusually resistant piece of wood. This might easily happen through the insect's shifting its feet again and again to obtain a better purchase, and would explain the whole matter very simply, as the ovipositor in such a case would naturally assume the position figured.

There can be no doubt at all that Mr. Ramsay's notes refer to *R. persuasoria* (Linnaeus), which has an extremely wide distribution through Europe to Canada and the United States in the West, and the Himalayas in the East, since it is to the best of my knowledge the only species attacking phytophagous larvae. *R. approximator* (Fabricius), is said by Holmgren to attack *Xyphydria prolongata*, which feeds in oaks; and there are several interesting accounts of the American species' economy¹⁷ and Harrington has¹⁸ put on record "The Nuptials of Thalessa." Mr. Ramsay appears to take it for granted that these insects bore for themselves an egg-passage through the solid wood; but it is by no means proved that they do not oftener introduce them along the tunnel of the host larva.¹⁹

¹⁷ Canad. Entom., xi, 1879, p. 15 etc.

¹⁸ L. c. xix, p. 206.

¹⁹ Cf. Morley, Ichn. Brit., iii, p. 25, and Revision Ichn. Brit. Mus. ii, p. 10

Genus **APECHONEURA** Kreichbaumer

Apechoneura Kreichbaumer, Ann. Naturh. Mus. Wien, v, 1890, p. 485.

Apechoneura Schmiedeknecht, Genera Insectorum, Fasc. 62, 1907, p. 60.

Apechoneura Morley, Rev. Ichneumon Brit. Mus., ii, 1913, pp. 3, 22, 23.

Genotype: *Rhyssa terminalis* Brullé.

The head is square with a distinct carina between the antennae. The antennae are long and filiform. The mesonotum is transversely rugose. The propodeum is distinctly areolated anteriorly, but posteriorly is less distinctly so. The transverse median nervure is straight, not broken. The sub-discoidal nervure originates from the median vein far beyond the apex of the sub-median cell. The areolet in the fore-wing is trapezoidal or three cornered, sessile, or shortly petiolated. The abdomen is long and cylindrical, with an ovipositor as long or longer than the body. The largest species usually have a dark spot in the tip of the wing.

Table to Species

This table is taken from Morley's Revision of Ichneumonidae, Part II. The types of these two species are in the British Museum, and therefore Mr. Morley has had an opportunity to examine them. Not having seen Mocsary's paper²⁰ I am unable to include his species.

Abdomen with only a discal line black.....**nigritarsis** Cameron

Abdomen black and flavous, not at all red.....**carinifrons** Cameron

Apechoneura nigritarsis (Cameron)

Rhyssa nigritarsis Cameron, Biol. Cent.-Am., Hymen., i, 1886, p. 260, ♀.

Rhyssa nigritarsis Schmiedeknecht, Gen. Ins., Fasc. 62, 1907, p. 63.

Apechoneura nigritarsis Morley, Rev. Ichneumon., ii, 1913, p. 23.

Type.—In the British Museum.

"Fulvo testacea; antennis, mesonoto (medio-excepto), linea metanoti, abdomine, supra tarsisque, nigris; alis hyaline, apice fumata. Habitat, Panama, Volcan de Chiriqui at 2000–4000 ft.

"Length 22 mm. Antennae nearly as long as the body, stout, gradually thickened towards the apex; the base testaceous on the lower side. Head, if anything, broader than the mesothorax, the face strongly punctured, the clypeus obscurely, transversely, striated, with two deep shining black depressions above the antennae, separated by a thin, rather sharp partition, vertex punctured in front, laterally behind the ocelli aciculated; mandibles black

²⁰ Ann. Mus. Nat. Hungar., iii, 1905.

at the apex. Pronotum reaching to near the top of the head, rising rather perpendicularly in front; the mesonotum projects a little over it, and rises from the scutellum to the apex, which has a distinct margin; the margin projects upward in the center and is depressed in the middle. Mesonotum transversely striated as usual and with a longitudinal furrow on each side of the apical three-fourths, scutellum shining, obscurely punctured, broader than long, slightly narrower towards the apex. Pleurae shining, obscurely punctured, a longish longitudinal hollow in the middle. The mesonotum is black except laterally in front and down the center. Scutellum testaceous, the sutures black. There is a longish black mark under the fore-wings; the base and apex of the metanotum, and a broad line down its center are black. The longish curved spiracles are bordered with black. Metanotum shining, impunctate, a curved transverse keel runs across its center and an oblique one from the spiracles to the apex. Abdomen shining, somewhat compressed, black above, the apex pilose, in the center of the penultimate segment is a somewhat triangular depression, covered with a white membrane; the last segment above forms a projecting thickly pilose lobe; on the lower side it projects more and ends in two horny processes which clasp the ovipositor. Ovipositor nearly three times longer than the body, white at the apex. Legs shining, the hind coxae black at the base on the lower side. Areolet large, triangular, receiving the recurrent nervure in the middle." Original description from Cameron.

***Apechoneura carinifrons* (Cameron)**

Rhyssa carinifrons Cameron, Biol. Cent.-Am., Hymen., i, 1886, p. 261, ♀ ♂.

Apechoneura carinifrons Schmiedeknecht, Gen. Ins., Fasc. 62, 1907, p. 60.

Apechoneura carinifrons Morley, Rev. Ichneumon., ii, 1913, p. 24.

Type.—In the British Museum.

"Testacea, nigro varia, antennis nigris, medio apicique subtus testaceis; pedibus rufo-testaceis; basis et apice coxarum posticarum, apice femorum, dimidio apicali tibiis posticarum tarsisque, nigris; alis hyaline, apice fumato. Habitat, Nicaragua.

"Antennae as long as the body, the base, the middle narrowly and the apex (except the extreme point), testaceous on the lower side. Face transversely punctured, the vertex impunctate, a distinct keel (separating the antennal depression) runs down from the ocelli to a little below the base of the antennae; eyes margined, especially on the inner side and above; testaceous, the mandibles, the antennal depressions, a broad transverse band on the vertex enclosing the ocelli and the hind region, black. Thorax formed as in *nigritarsis*, testaceous; the mesonotum (except a broad mark on the center), the sutures, the base of the metanotum broadly, the sides of the prothorax in front, a large mark on the mesopleura, and the metapleura close to the sternum, black. In the center of the metanotum two short keels run from the transverse keel, forming a somewhat square area. Abdomen black; the ventral surface, a longish mark at the base of the first segment in the center, its apex and the apices of the other segments broadly testaceous. The middle coxae are black

beneath, the hind coxae are black on the lower side at the base and bear a longer black mark on the apex above, on the inner side they are entirely black except a small testaceous spot; the hind femora are infusate toward the apex, and more than the apical half of the hind tibiae is black, tarsi black, testaceous in the middle. What appears to be the male from Panama differs from the specimens from Nicaragua in having a broad white band on the antennae close to the apex and the yellow on the head and legs brighter in tint; there is no black on the coxae nor are the hind femora infusate toward the apex; the black on the hind is only on the outer side; and the abdomen is broadly dilated laterally at the apex."

This species was originally described by Cameron as *Rhyssa carinifrons* but in the Genera Insectorum it is placed in *Apecho-neura*, probably on account of the carina between the antennae and its areolated propodeum.

Genus **PSEUDORHYSSA** new genus

Genotype: *Pseudorhyssa sternata* new species.

This genus is characterized by its abdominal sterna being entire instead of being separated by a median longitudinal groove. It has an areolated propodeum consisting of three areas. The nota of the second and third abdominal segments are laterally bordered with a ridge forming a depression, which is not found in the other Pimplini genera which have the transversely rugose mesonotum. There is no carina between the antennae.

Pseudorhyssa sternata new species

Type: ♀; Toronto, Ontario, Canada. August 20, 1892. Collection of the American Entomological Society, Type No. 4007.

Six paratypes in same collection.

The females of this species range from three-quarters of an inch up to an inch and a quarter in length. The head is black, polished, and slightly punctured. The clypeus varies in outline from unidentate to bidentate. Below the antennae the face is brown marked by two parallel longitudinal yellow bands, which extend from the base of the antennae to the clypeus. On the base of each mandible is a yellow spot. The clypeus is rufous at its base and darker at its tip. The palpi are yellowish-white marked with black. The antennae are dark brown to black, and the scape has a yellow spot beneath. The thorax is black and bears a number of short, erect, whitish hairs. The pronotum is deeply excavated on both sides, highly polished and almost impunctate. The first thoracic spiracle is bordered with yellow and this color may extend forward for a short distance on the upper border of the pronotum. The tegulae are yellow. The mesonotum is flat on top and is separated from the prescutum, only by two short parallel longitudinal grooves along its anterior portion. Posteriorly the prescutum is continuous with the

mesonotum, the transverse rugulae of the latter passing over the former in a continuous line. The anterior portion of the prescutum is punctured.

The mesopleura are smooth, polished on their superior portions, punctured and clothed with short white hairs on their inferior portions. A short groove extends forward on the mesopleura from the mesoepimeron, starting at a point about two-thirds of the distance from its base to its apex. The mesoscutellum and metascutellum are smooth on their sides, with oblique to longitudinal striations, their centers are punctured and clothed with hairs. The metathorax is smooth, slightly punctured and clothed with short, white hairs. The propodeum is coarsely punctured, except for a dorsal area enclosed by ridges, which is polished and but slightly punctured. These ridges start at, or near the base of the segment, pass posteriorly, as two gradually diverging straight lines for about two-thirds its length, where they become circularly dilated to such an extent, that at their posterior extremities they reach to the lateral margins of the notum, thus forming three areolated areas on the propodeum. The wings are hyaline, tinged with yellow, the nervures and stigma are dark brown except at their base, where they are lighter. The recurrent nervure is interstitial with the outer transverse cubitus. The legs are rufous, paler beneath. The tarsal segments are sometimes darker towards the tarsal claws, which are also dark. The posterior femora each have a dark spot on its extremity. The posterior tarsi are darker than the others. The abdomen is coarsely punctured and irregularly wrinkled. The notum of the second abdominal segment is laterally bordered with a strong ridge. From each anterior extremity of the notum extends a ridge to its apex. These ridges gradually converge and enclose a median longitudinal channel, which at its base is polished and impunctate but becomes coarsely punctured and irregularly wrinkled. From this depression a number of transverse wrinkles extend to the lateral margins of the notum. The pleura of this segment are coarsely punctured and do not fuse with the notum. There is a small obtusely rounded projection on the outer margin of the segment at the point where the ridges end. This projection is bordered by a rufous streak. The notum of the third segment has transversely wrinkled, oblique depressions extending from either side of the projecting lobe of the second segment outward to the lateral margin of the notum. The rest of the notum is coarsely punctured and irregularly wrinkled, except a raised portion at the truncate, outer margin which is finely punctured. The sternal plates are not divided by a median longitudinal groove, consequently there are no mid-ventral projections. This segment, as are also the fourth, fifth, and sixth, is bordered with a rufous band. The remaining segments are coarsely punctured and irregularly wrinkled on their nota. The fifth, sixth, seventh and eighth segments have truncate outer margins laterally, with slight emarginations on their nota. The ovipositor is longer than the body, dark brown but lighter at its tip, with darker colored sheaths.

This species is described from seven specimens, one each from "Maine," "Colorado" and "Toronto, Canada," and four from "Washington Territory." It may be distinguished from *Megar-*

hyssa, *Rhyssa*, and *Epirhyssa* by its entire abdominal sterna, areolated propodeum, and by the excavations on the nota of the second and third abdominal segments, and may be distinguished from *Apechoneura* by the absence of a carina between its antennae.

Unlocated Species

Thalessa ? histrio Krichbaumer

Thalessa? histrio Krichbaumer, Ann. Naturh. Hof-Mus., Wien., v, p. 487, ♂.

"Head, thorax, and feet black, varied with rufo-flavous, abdomen rufous, base black segments 1 and 2 banded, 3 on both sides, apical spots flavous. Wings hyaline, stigma flavous, this sunken triangular spot and apex of the wings fuscous, areola wanting. Length, 13 mm. Because of the absence of the areola perhaps forming a proper genus, which I have omitted to establish since the female as yet unknown might fail to show the very imperfect characteristic marks. Head flavous, apex of mandibles, eyes, occipital bands beneath on both sides reddish, ocellar region, the line on the vertex joined with it, and antennae black, of this the first two segments beneath, the upper line and two facial sutures rufous. Thorax black, nearly the whole margin of the anterior pleura, pronotum, two longitudinal striae and two punctures before the mesonotum, striae below the wings, tegulae, scutellum, postscutellum, three lateral metathoracic spots, tip of dorsum near place of junction, slightly golden-yellow. Nearly the whole of the anterior coxae, the posterior above and on the sides flavous, summit angulated and below fuscous, anterior trochanter flavous, dark punctured, posterior ones fuscous, top flavous or rufous, hind part more or less fulvous, in front flavous, above rufous, banded, on both sides, posteriorly below fuscous lined, posterior rufous, top flavous, anterior tibiae and tarsi flavous, posterior rufous, base of exterior radial nervure of wing irregularly bent. Forceps on the last anal segment short on top, summit triangularly greatly impressed, segments straight. Ends of segments abruptly truncated.

Habitat: White Mountains."

EXPLANATION OF PLATES

Plate XII

Fig. 1.—Antenna of *Megarhyssa lunator*.

Fig. 2.—Maxilla of *Megarhyssa lunator*.

C—cardo. G—galea. L—lacinia. P—palpus. S—stipes.

Fig. 3.—Head of *Megarhyssa lunator*.

CE—compound eye. CL—clypeus. GE—gena. L—labrum. MD—mandible.

Fig. 4.—Mandible of *Megarhyssa lunator*.

Fig. 5.—Dorsal view of thorax of *Megarhyssa lunator*.

Fig. 6.—Lateral view of thorax of *Megarhyssa lunator*.

a2—second abdominal segment. ex1—procoxa. ex2—mesocoxa. ex3—metacoxa. epm2—mesoepimeron. epm3—metaepimeron. eps1—proepisternum. eps2—mesoepisternum. eps3—metaepisternum. n1—pronotum. ppct2—prepectus. pse2—prescutum. sp—spiracle. sel2—mesoseutellum. sel3—metaseutellum. set2—mesoseutum. set3—metaseutum. tg—tegula. tsp—thoracic spiracle.

Plate XIII

Fig. 1.—Abdomen of *Megarhyssa lunator*.

Fig. 2.—Sternal plate of abdomen of *Megarhyssa*.

Fig. 3.—Sternal plate of abdomen of *Rhyssa*.

Fig. 4.—Second abdominal segment of *Rhyssa*.

Fig. 5.—Second abdominal segment of *Megarhyssa*.

Fig. 6.—Hind leg of *Megarhyssa lunator*.

Fig. 7.—Fore leg of *Megarhyssa lunator*.

Plate XIV

Fig. 1.—Fore wing of *Megarhyssa lunator* according to Snodgrass.

1—costal vein. 2—sub-costal vein. 3—radial vein. 4—median or externo-median vein. 5—anal, sub-median or interno-median vein. 7—basal vein. 9—cubital vein. 11—transverse cubital vein. 12—transverse cubital vein. 13—transverse medial vein. 14—discoidal vein. 15—subdiscoidal vein. 16—first recurrent vein. 17—second recurrent vein. 19—stigma.

Fig. 2.—Fore wing of *Megarhyssa lunator* according to Cresson.

a—costal and sub-costal nervures blended. b—externo-medial nervure. c—anal nervure. d—basal nervure. e—marginal or radial nervure. f—first transverse cubital nervure. g—second transverse cubital nervure. h—transverse medial nervure. i—abbreviated cubital or stump of nervure. j—discoidal nervure. k—cubital nervure. l—recurrent nervure. m—subdiscoidal nervure. n—stigma.

Fig. 3.—Hind wing of *Megarhyssa lunator*.

a—costal nervure. b—sub-costal nervure. c—externo-medial nervure.
d—anal nervure. e—marginal or radial nervure. g—discoidal nervure.
h—transverse medial nervure. i—transverse cubital nervure.

Fig. 4—Fore wing of *Megarhyssa lunator*.

Fig. 5—Hind wing of *Megarhyssa lunator*.

a—anal. c—costa. d—cu. cubitus. r—radius. sc—sub-costa. m—
medius.